Photonic crystal microcavities for spontaneous emission control

L. Le Gratiet, S. Laurent, S. Varoutsis, F. Raineri, A. Lemaître, I. Sagnes, I. Robert-Philip, and I. Abram,
CNRS - Laboratoire de Photonique et de Nanostructures,
Route de Nozay, 91460 Marcoussis, France.

The fabrication of semiconductor resonant cavities, which trap light within a finite volume to enhance the interaction between the electromagnetic field and a single quantum dot embedded in the cavity, is one of the current challenges in photonics. It would make possible exciting new applications in quantum optics ranging from efficient single photon sources to single dot lasers. We are developing such sources, based on single self-assembled semiconductor quantum dots embedded in two-dimensional photonic crystals cavities etched in a GaAs membrane suspended in air or lying on an AlOx layer. In these structures, the 2D photonic crystal lattice provides in-plane confinement while index guiding is used to achieve confinement in the vertical direction.

In this talk, we shall discuss the technological issues associated with fabrication of such resonators. The photonic crystal cavity is fabricated by etching a triangular lattice of air holes in a 180 nm-thick GaAs membrane. The lattice constant of the photonic crystal is about 260 nm with a hole radius around 80 nm in order to obtain H1 (one-hole-missing) cavities operating in the 900-1000nm range. These cavities are fabricated through a three-step process which makes use of electron-beam lithography, reactive ion etching and chemical etching or oxydation to form the membrane. For single-hole defect cavities, suspended in air or lying on an AlOx layer, characterization measurements will be presented using the photoluminescence of layers of self-assembled quantum dots emitting around 950 nm as probes of the cavity modes.